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observations of the sun, stars, and nebulae. And I might add, if I thought it would strengthen the argument, that the light gas helium, which was first produced on a large scale during the war, and would have rendered the great bombing dirigibles of the Allies practically safe over Berlin, because of its non-inflammable and non-explosive character, was discovered in the sun a quarter of a century before it was found on the earth.

But I have said enough, I hope, to convince you that astronomy has been of real service to the world, and that its study should be continued, especially in this prolific period when our understanding of the extent and nature of the universe is advancing more rapidly than ever before. And if the present duty of the astronomer to advance the knowledge of his science is plain, that of the investigator in every other field is equally so. He should go back to research, with new vigor and redoubled energy, without troubling himself for a moment with the question of immediate practical return.

Industrial research must be enormously developed in the United States, and the old distinction between pure and applied science must be swept away.² But once awakened, as they already are, the industries may be trusted to follow the example of the duPont Company, which began with five research chemists in 1902, and spent three millions in their research laboratories during 1918. The task of the educational institution and of the private research foundation under such conditions is a tremendous one. They must not only develop investigators capable of doing the work of the industries, as the German universities have done for so many years; they must also push forward, on a far greater scale than ever before, their researches for the advancement of knowledge. Only thus can the highest advantage of science and industry, the chief interests of public welfare, and the greatest national progress, be attained.

GEORGE ELLERY HALE

MOUNT WILSON OBSERVATORY

² See Hale, "The National Engineering Societies and the National Research Council."

THE PRESS AS AN INTERMEDIARY BETWEEN THE INVESTIGATOR AND THE PUBLIC¹

It is with some diffidence that as a rank amateur I accept the invitation of so learned a body to make any suggestions even upon that branch of your work upon which we are all amateurs. But perhaps just because it is a question, not of the discovery of truth, but of the promulgation of that truth to the unprofessional public, there may be some advantage in approaching it from the standpoint of a mere member of that public.

I am not sure that there is unanimous or immediate consent to the doctrine that any merely popular intermediary between the investigator and the public is even desirable. Certainly there has in the past been enough of aloofness on both sides, for which neither side has been guiltless. Even where science has not inherited the jealous exclusiveness of a professional guild, the original investigator had had temptation enough to remain aloof from the public. If his discoveries were of any practical use, others would advertise them soon enough. If they merely opened wider the portals of truth, the public was little interested, and there would be time enough for its enlightenment when the ponderous monograph became a sentence or a footnote in the elementary text-books. Besides, it seemed so hopeless to give the public what it ought to have, and so worse than useless to give it what it wanted. The whole mental viewpoints were different. The scientist is cautious, accurate and impersonal. He uses his imagination, not to jump at conclusions, but as a guide to experiment and investigation. He hesitates to announce a discovery until he has fully verified it, and then he limits himself strictly to the one step he has taken into the Unknown, and avoids flights of fancy into its speculative possibilities. If his knowledge is fragmentary, he refuses to fill out its gaps, and he is resolutely non-committal on what he does not know. He cultivates an imper-

¹ Read before the Pasadena Division of the American Association for the Advancement of Science, June 20, 1919.

sonal impartiality, and even on a controverted question he would scorn to win a victory over an opponent by misstating or understating that opponent's position or evading any of the evidence for it. The public, on the other hand, demands cocksureness, especially on all the consequences which a discovery suggests to the imagination. It is intensely personal, and inquires first what use it can make of the discovery, or whether it confirms or opposes its prejudices. It undervalues accuracy, overvalues vivid picturesqueness, and does not understand impersonality or impartiality at all. It jumps at conclusions, and refuses to take "I don't know" for an answer. How shall the scientific man condescend to such a rabble without losing his soul?

The public, on its side, is as little ready to appreciate the scientist. Personally, it regards him as a freak. If he happen to have the personality that would be valuable to a business man—an impressive presence, an aggressive, decisive manner and the executive temperament which decides everything instantly and positively and sees that it is done—he may be respected for these qualities. But if, as is usually the case, he is not chiefly notable for these qualities, he is regarded as an "impractical dreamer," who may, by some hocus pocus, produce miracles from his magic box, but is personally entitled to no consideration. Then there is the persistent illusion of "book larnin'." Because most of the elementary education with which the public is familiar is derived from books, it is assumed that, higher learning is also derived from books, and that a "professor" is merely a man who has stuffed his brain with many books. The books themselves are taken as ultimate facts, and the question, Who wrote the books? or, Where did he find out the things in them? never occurs to the mind. Even the great classics of science, like the "Origin of Species," are conceived after the analogy of the classics of theology, and Darwin may be assumed to have propounded his alleged dogma that "man descended from the monkey" much as Calvin propounded predestination or Wesley the direct conviction of

salvation. And if there come rumors that some one—de Vries, for instance—has "disproved Darwinism," it is at once assumed that he is merely the leader of a new sect with a different creed. As to the strange jargon in which scientists are wont to express themselves, that is merely funny. Anyhow, scientists are a rather contemptible tribe. For if there is anything more contemptible than not knowing the particular thing I know, it is knowing something else that I do not know. It is by this compensatory contempt for the knowledge of others that we retain our self-respect in the face of our ignorance.

And I may suggest that the breaking down even of this merely personal barrier between the scientist and the layman is of immense importance to our American democracy. For our most grievous lack, as a people, is our ignoring of experts, and our fiction that "any man is fit for any job." The one German lesson which we must not permit the war to unteach us, but which it must rather emphasize a thousand fold, is the lesson of valuing and trusting the expert. It was by the misuse of the efficiency which this lesson taught her that Germany was able to stand off the world for four years, and nearly succeeded in destroying the civilization which her science had helped upbuild. If we should jump at the mad conclusion that the things which proved dangerous in the hands of autocracy for the destruction of civilization shall therefore not be used by democracy for its upbuilding, we might inflict on the world an even greater damage than that wrought by German arms. It is therefore the duty of the American expert, even at the cost of some repugnant self-exploitation, to make himself personally respected by the democracy. And he can not do that in his laboratory and through the scientific journals alone.

For any large-scale contact with the general public, the popular press is indispensable. This press may be divided into three groups—the daily newspapers the Sunday newspapers and the popular magazines.

By far the most efficient organ of publicity is the daily newspaper. Everybody reads the

newspaper every day, and most people read nothing else. Therefore, whatever of scientific truth or of the scientific spirit you can get into the daily newspaper will reach farther than it can do in any other way. But it is necessary to realize the narrow scope and the fixed perspective of the newspaper. The daily newspaper deals in just one thing—in news. If you see anything else in the paper, you may be sure that it got there under protest, as a regretted necessary evil. What is news may not be easy to define, but we may indicate it negatively by pointing out what it is not. In the first place, things are not printed as news because they are useful or useless, beneficial or injurious. You can not get anything into the paper by proving that it would be beneficial or useful, nor keep anything out by proving that it might be useless or injurious. Also, the eternal verities are not news, though a temporary and adventitious fact regarding them may be. And a thing which is news here to-day is quite likely not to be news to-morrow and elsewhere. The space and time element absolutely dominate the news. In fact, that may be made a handy negative test of news. The surest way to know that something ought to be printed in to-day's paper is to show that it would be absolutely unthinkable to print it in yesterday's or tomorrow's paper. And the news must be so attached to a particular place and person that it would be ridiculous to attach it to any other place or person, or to omit the place and personal element. If you can write a scientific truth so that the principal statement of it shall be in the first sentence, and the most important words in that sentence are "here," and "to-day," and your own name, and especially if you can so write it that it would be absurd to date it at any other place, on any other day, or with any other name, then you can probably get it into the newspaper. And after you have accomplished that one sentence, which makes it news, it is astonishing the amount of eternal verity you may append thereto, and still "get by" with it. But don't attempt to exploit the eternal verities on their own merits. They are not newspaper merits.

The second condition of news is, of course, human interest. *News is any humanly interesting thing, which happens in some particular place, to-day.* Very many subjects of scientific investigation, including some things of educational value as to scientific method, come within this definition. Professor Ritter's investigations of the relation of sea temperatures and rainfall, or of the migration of food fishes, have intense human interest, and if it can be stated that "Professor Ritter discovered, at La Jolla, to-day," or "announcement was made, at La Jolla, by Professor Ritter, to-day," then the time, place and personal factor are added, which make them news. Most of the chemical investigations of the war, at whatever date they can be announced, are intensely interesting news—the synthesis of glycerine from sugar, for instance; the extraction of rubber from desert shrubs, or the development of new and rare metals. The beginning and the end of the kelp industry, and the belated announcement of war by-products, are news—the day they happen or are first given out. The human facts regarding the service of scientific experts to the war are news, when given out. The war has made chemistry respectable, to the popular imagination, just as the discovery years ago, by Professor Walter Dill Scott, that psychology would make money in advertising made psychology respectable. Even astronomy has rendered enough service in this war to make it respectable, if the facts were given out.

Scientific methods seem particularly hard to make news of, but our agricultural scientists have succeeded in doing it. The one thing necessary, to gain the confidence of the practical farmer in the farm adviser, was to remove the illusion that the farm adviser was a book-learned man. When the farmer learned that the farm adviser found out things the same way he did, only more systematically and more exactly, then his knowledge became respectable. By trying practical experiments, in places where they became news; by collating practical results from their application; by putting a sporting interest into pig clubs; by making speeches at farm meetings and get-

ting them into the newspapers (a speech is news, when it is delivered, even if it is about the eternal verities) the farm advisers, as the outposts of agricultural science, have largely solved the problem which the rest of you are facing, of bridging the gap between the scientist and the people.

Medical science, because it is subject to hostile controversy stands particularly in need of publicity, not merely as to its results, but as to its methods. There is a popular delusion that the established facts of medical science are sectarian dogmas, deniable by any one who chooses to propound the contrary dogma. The isolation, therefore, of a new disease germ means nothing to the reader who "does not believe in the germ theory." But if the facts are given out that this germ, isolated from patients sick of the disease, was cultivated for many generations outside of the body, was inoculated in susceptible animals and uniformly produced the disease, and was finally tried on volunteer men and produced the disease in them the knowledge of these facts, which have of course been commonplaces of scientific methodology since Koch, will increase popular confidence in the soundness of medical conclusions, by showing the soundness of the methods by which they are reached. But this sort of publicity is frequently prevented by scientific squeamishness. For instance, army research laboratories, during the recent influenza epidemic, succeeded in isolating the bacillus of Pfeiffer from most of the cases, at least in the early part of the epidemic. I know of at least one such laboratory in which inoculations of fifty volunteer men with pure cultures was followed by clinical influenza in forty-eight, with incidental pneumonia in four or five cases. These results were never given out. But in a certain army hospital, twelve soldiers had their noses sprayed with what was said to be a pure culture of some influenza bacillus, with negative results. This result was given out and got on the wires. The result was that every apostle of medical unorthodoxy in America had a clipping in his pocket, giving this alleged demonstration that influenza is not a germ disease. Nothing will counteract

this sort of propaganda, but the truth, promptly, unsqueamishly and if necessarily immodestly proclaimed.

But I have gone on too long on my favorite subject of the daily newspaper end of the subject. Let us consider the still more shocking problem of the Sunday newspaper.

Because of the great amount of advertising in the Sunday newspapers, it becomes necessary to print an excessive amount of reading matter, to float that advertising. The news, as the more buoyant medium, is spread as far as it will go, but it is not enough, and for the rest the newspapers have recourse as a last desperate resort, to literature, science and the arts. Being regarded with contempt, as rubbish in comparison with the news, naturally the standard of selection of these unavoidable evils is far from idealistic. I am not recommending the literature of the "Sunday Sup.," and I share your horror of most of its science. But the point is that there is a page of science there, and where bad science is, surely good science might go. It must, to be sure, be well "yellowed up." If a disease germ can be attached to some well-known man or a geological truth to some recent calamity, so much the better. And it will not do to banish entirely the speculative imagination. May not the rumors of the sea serpent be based on the survival of some monster of a former age? How would the earth look to the inhabitants of Mars, if there are any, and what chest measure would they have to have to breathe its thin air, and how high could they jump? Can the creatures of the abyss teach us the mystery of cold light? Can synthetic chemistry feed mankind when the earth becomes too overpopulated for animal and vegetable food? These may be childish questions, but at least it is better to answer them with truth than with falsehood. And if the scientist will bring himself to realize the primary importance of the picturesque and the human interest, as unlocking the key to the "Sunday Sup.," he can then at least do something toward keeping scientific nonsense out of this the most widely circulated of all scientific

publications, and he may do something toward getting scientific truth into it.

May I also add just a word on political science?

It is one of the calamities of democracy that most economic and social problems are first worked out by experts, who embalm their results in books which are interred in university libraries, and are then, long after, worked out by rule of thumb, by practical politicians and business men. One of the supreme problems of our universities is to bridge this gap.

Of the popular scientific magazines, I scarcely need speak. You know them better than I do. But do they need to appeal so nearly exclusively to the mechanical curiosity of boys? Some magazines, like *Good House-keeping*, are doing excellent work in popularizing dietetic science among women. Is there not some way to penetrate the indurated intellects and the atrophied imaginations of our adult men, also?

I realize that I have added little to your knowledge of any subject, by these desultory remarks. May I hope, however, to have aroused at least a little unscientific curiosity?

CHESTER H. ROWELL

EMIL FISCHER

THE news has just reached us that Emil Fischer is no more. Since the fateful August, 1914, Germany has lost her Ehrlich, her Buchner, and her Baeyer; England, her Ramsay, Crookes and Moseley. Deaths occur, wars or no wars; yet Buchner might have lived had not a shell cut short his existence; and young Moseley had barely started along his brilliant career when he, like the promising Rupert Brooke, laid down his life for his beloved England. Ramsay's end, we know, was hastened by manifold war duties. To what extent Fischer was a victim of the war is still unknown to us; but we were told, from time to time, of his violent pan-Germanism, doubtless encouraged by the exalted position he held under the crown.

The magnitude of Germany's *débâcle* would have crushed a spirit less proud than *Geheimer-Regierungsrat* Fischer.

What ever opinions we may have regarding Fischer's political affiliations there can be no question of his position in the history of chemistry. His bitterest enemies are the first to pay tribute. He easily takes his place among the greatest organic chemists of our generation.

To appreciate his work a little more we must look into the state of the science when Fischer began his labors.

That animal and vegetable life were largely made up of carbon compounds, that the food we eat could be largely divided into fat, proteins and carbohydrates—all this was known. If, then, a knowledge of the composition of these substances, as truly belonging to organic chemistry as marsh gas or benzene, was vague and wholly unsatisfactory, this was due to the complexity of their make-up. Chevreul and Berthollet had largely cleared the situation in so far as the fats were concerned, but the chemistry of the carbohydrates, and particularly that of the proteins, remained as mysterious as ever. The three foodstuffs were the borderland where chemistry ended and biology began; the lack of a solution of the composition of at least two of these foodstuffs left the finishing touches of the edifice of organic chemistry still undone, and gave a wholly unsatisfactory foundation for the science of physiology.

To the solution of this problem Fischer pledged his life while still a student, and brilliantly did he fulfil his life's task. With an imagination tempered only by a splendid scientific training, an originality of mind which made a lasting impress upon every piece of work with which he was associated, and a rare skill in devising apparatus, he, first by his own labors, and